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ASSESSMENT OF AWARENESS AND ADOPTION OF LEAN PRACTICES IN THE NIGERIAN BUILDING INDUSTRY

O. D Babalola
Architecture Department, Covenant University, Ota, Nigeria

E. O. Ibem
Architecture Department, Covenant University, Ota, Nigeria

I. C. Ezema
Architecture Department, Covenant University, Ota, Nigeria

ABSTRACT

The construction industry globally is faced with challenges of time overrun, cost overrun, and material wastage. In order to address these challenges, the lean production approach has been adopted in the building industry, which is a subset of the construction industry. Although several studies have examined various aspects of lean practices in the different countries, studies on the adoption of lean principles and practices in Nigeria are grossly underrepresented in the research literature. This study investigated the levels of awareness and adoption of 32 lean practices by firms in the Nigerian building industry. A questionnaire survey was conducted in five cities of Abuja, Enugu, Kaduna, Lagos, and Port-Harcourt in five geo-political zones of Nigeria. Totally, 446 participants drawn from architectural, building consulting and contracting and quantity-surveying firms in the five aforementioned cities provided the data for this research. The data were analyzed using descriptive statistics, and the result shows that whereas around 67% of the respondents claimed that they are aware of lean practices in construction, about 47% of the firms have adopted one form of lean practices or the other. It was also observed that the three most adopted lean practices among the 32 investigated were Visual Design Construction (VDC), Total Quality Management (TQM) and Team Work/Partnering, respectively. This study implies that although there is a growing knowledge about lean practices among firms in the Nigerian building industry, the level of adoption of individual leans practices by the firms is generally low. Therefore, for the building industry to maximise the benefits of the lean production approach, appropriate steps need to be taken to ensure a critical mass uptake of lean practices by firms in this vital sector of the Nigerian economy.

Keywords: Building industry; Lean practices, Lean production, Nigeria, Questionnaire survey

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1. INTRODUCTION

The building industry has been identified with numerous several challenges that seek to limit its sustainability and efficiency in delivering value for money to clients and end-users. Some of these challenges are associated with the sluggishness of stakeholders in the industry to adopt new technology and equipment when compared with other industries (Laryea and Ibem, 2014), insufficient local materials, frequent change in governments and policies among others (Iheme, Ngwu, Okoro, Oyoyo and Iroegbu, 2011). Hussin, Rahman and Memon (2013) and Oyewobi, Ibironke, Ganiyu and Ola-awo (2011) have also alluded that amongst the challenges confronting the growth and development of the building industry, time overrun, cost overrun, and material waste are very critical as they combine to have negative impacts on the efficiency of firms in the delivery of building projects.

Several studies have been carried out in the different countries of the world, especially, on how to eliminate or manage wastes in the building industry. One area research attention has been focused on in the last four decades is the integration and implementation of lean practices and principles in building design and construction. The review of literature reveals that authors in the different countries including, Alarcon, Diethelmand and Rojo (2002) in Chile; Salem et al. (2006); Salem, Solomon, Gnaidy, and Minkarah (2006) in the US; Ayarkwa, Agyekum, Adinyira and Osei-Asibey (2012) in Ghana; Franco and Picchi (2016) in Brazil and Sarhan, Xia, Fawzia, and Karim (2017) in Saudi Arabia have carried out research on lean construction practices with interesting and insightful findings.

In Nigeria, Oladiran (2008) revealed that the level of awareness of lean construction among stakeholders in the building industry was low but however insisted that there was a high level of readiness among stakeholders to implement LPs in the construction industry. Moreover, findings of the study by Adamu, Howell, and Hamid (2012) indicated that some aspects of LPs have been implemented in mass housing scheme in this country. Ahiakwo, Oloke, Suresh, and Khatib (2012) however noted that in spite of the huge benefits associated with LPs, the extent of their adoption in the design and construction of building projects has not been adequately investigated in Nigeria. It was an attempt to bridge this gap in research and improve understanding of the current state of knowledge and adoption of lean thinking among stakeholders in the Nigerian construction industry that this study sought to investigate the levels of awareness and adoption of lean practices in the Nigerian building industry. In order to achieve this aim, two key research questions were developed for the research. These are:

What is the level of knowledge of the different aspects lean practices among firms in the Nigerian building industry?

Which of the existing lean practices are most commonly adopted by firms in the Nigerian building industry?

This study is based on a survey of 446 firms in five of the six geo-political zones of Nigeria. The study makes contribution to knowledge by providing a fresh understanding of the knowledge base of firms in the Nigerian building industry on lean practices. It also uncovers the most commonly adopted lean practices in the Nigerian building industry, and thus adds to

the current discourse of lean construction from the Nigerian perspective, which is currently under presented in the research literature.

2. LITERATURE REVIEW

2.1. Concept of Lean Practices

Copious evidence in the published literature reveals that some of the approaches and strategies so far implemented with the aim of addressing some of the key challenges in the building industry include waste management, design and build, waste efficient procurement and others (Babalola, Ibem & Ezema, 2019). However, Ajayi, Oyedele, Bilal, Akinade, Alaka, Owolabi, and Kadiri, 2015 (2015) revealed that most of these strategies have not been very effective because they can only help to manage already generated wastes and do not help in preventing the generation of waste in building design and construction projects. In the attempt to reduce the high incidence of time overrun, cost overrun and material waste in the construction projects experts and researchers have identified lean philosophy as an approach that can be very effective in the reduction of physical and non-physical wastes in the procurement of building and infrastructure projects. Lean philosophy originated from the manufacturing industry and found its way into the construction industry due to the results observed in the Toyota mass production scheme. In fact, the existing studies (Koskela, 1992; Morgan and Liker, 2006; Salem *et al.,* 2006) reveal that the adoption of lean principles has been instrumental in achieving minimization of activities that do not really add value in the production process. Consequently, the lean thinking is being celebrated as the right way to go in sustainable production process in the manufacturing and other industries that desire to achieve value for money for clients and end-users.

In construction, lean practices have become attractive in managing and improving the construction process by achieving delivery of customers' need profitably (Constructing Excellence, 2004). Though the implementation of lean practices is not yet well established in the construction industry when compared to other industries like manufacturing, construction industry stakeholders view the adoption of LPs as departure from the traditional construction process; and thus it is an innovative way to improve the performance of the industry in meeting the demands of contemporary society (Erol, Dikmen and Birgonul, 2016). According to authors (Abdelhamid, 2008; Aziz and Hafez, 2013), lean construction is a departure from the traditional construction process because it seeks to deliver best value for money by adopting strategies that ensures efficiency and enhanced productivity in the entire lifecycle of projects.

2.2. Awareness and technology adoption

According to Merriam-Webster dictionary, awareness can be described as the quality or state in which one is aware or have knowledge and understanding about the existence of something or occurrence of an event. It also means being conscious of the existence of something or an occurrence/event. Therefore, in the context of this paper, awareness is used to describe the knowledge about the existence of lean construction practices.

In Rogers' innovation diffusion theory (Rogers, 2003) awareness has been identified as the first stage in the adoption an innovation, in the form of an idea, product or process of doing things. This has also been discribed as the knowldege stage when the potential adopter seeks to know about the innovation by acquiring knowledge and information about it.The knowldege sought at this stage of innovation-decision process is basically awareness knowledge, wich may include knowing how the innovation works and and how to apply or use it. The awareness knowledge, involves the individual taking cognisance of the innovation, and this alone has the

ability to make a potential adopter to decide to adopt the innovation or to get more knowledge on the procedure for using the innovation. In fact, the knowldege of how to use the innovation is essential in infroming the adopter how the innovation can be used. This makes the potential adopter to have adequate konwldege of how the innovation operates and why it operates the way it does (Rogers,2003).

Whereas a previous study in Ghana (Ayarkwa *et. al*., 2012) revealed that there was a good level of awareness among practitioners, studies in countries such as Germany (Johansen and Walter, 2007), Turkey (Tezel, and Nielsen, 2013) and Ethiopia (Ayalew, Dakhli, and Lafhah, 2016) indicated that there was a low level of awareness of lean construction in among people in the construction sector. In Nigeria, an earlier study by Olatunji (2008) suggested that the level of awareness of lean construction practices among stakeholders in the Nigerian building was also low. However, this study was not based on a nationwide survey of industry stakeholders, and thus this finding cannot be taken as the true situation in this country. In view of this and coupled with the fact that that study was conducted almost 10 years ago, it was necessary to ascertain the current situation. This is the key motivation for the current study, which among other things sought to investigate the current state of knowledge of lean practices in the Nigeria building industry.

2.3. Adoption of Lean Construction Practices

Generally speaking, lean construction is hinged on five major principles which are specification of value, identification of value stream, continous flow, pull scheduling and perfection pursuance (Womack and Jones, 1996). Lean practices as used in this study refer to tools, approaches, strategies or techniques used in the achievement of these aforementioned objectives of lean (Marhani, Jaapar, Bari and Zawawi, 2013; Zhang and Chen, 2016; Jamil and Fathi, 2016; Ansah, and Sorooshian, 2017). From the review of published research literature 32 lean practices were identified and the list is as presented in Table 3. It was also found that these 32 lean practices have been implementated or adopted in the different kinds of buildings and infrastructure projects in the various countries (please see fro examples Johansen & Walter, 2007; Al-Aomar, 2012; Andersen, Belay and Seim, 2012; Ogunbiyi, 2014; Limon, 2015; Franco and Picchi*,* 2016;Vaidyanathan, Mohanbabu, Sriram, Rahman and Arunkumar, 2016; Wu, Zhou and Liu, 2017; Sarhan, Xia, Fawzia, and Karim 2017; Sarhan *et al.*,2017; Babalola *et al*., 2019).

From these studies cited here, there is no conclusion on the general pattern of adoption of lean practices globally. However, there are peculiarities in the different countries and the levels of adoption differ from one country to another. In a survey of practitioners on the degree of knowledge and possibility of lean techniques application in Nigeria, Olatunji (2008) reported that there was no lean construction implementation but concurrent design and construction, just-in-time material deliver were being practiced by some companies within the context of the traditional construction approach. Ahiakwo, Oloke, Suresh, and Khatib (2013) carried out a comparative analysis of three projects executed using the traditional construction method with that of which last planner system lean construction practice was adopted in Nigeria. The result revealed that there was a significant improvement in the time of completion of project, and about 30% of project cost was saved. Furthermore, the authors alluded that some efforts have been made towards the identification of stakeholders' readiness, barriers, strategies, and approaches that can help in lean practices adoption in the Nigerian building construction industry (Oladiran, 2008; Ahiakwo, Oloke, Suresh and Khatib, 2012 and Aniekwu and Igboanugo, 2012). In spite of the insight gained from these authors, there is still the lack of

understanding of the most commonly adopted lean practices in the Nigerian building industry. This is one of the research gaps this study attempted to fill.

3. RESEARCH METHODS

The data used in this article were drawn from a bigger research project aimed at investigating the adoption of lean practices in the Nigerian building industry. It is an exploratory study; and thus the research design was a survey and quantitative research approach was adopted. The data were collected using structured questionnaire administered to architecture, building consulting and contracting, and quantity surveying firms in five selected cities in Nigeria. One city with the highest number of firms was purposively selected from each of the 5 geo-political zones in Nigeria excluding the Northeast, where there are massive insecurity challenges. The cities selected for the surveys were Abuja (Northcentral zone), Kaduna (Northwest zone), Enugu (Southeast zone), Port-Harcourt (Southsouth zone), and Lagos (Southwest zone).

The study population for this research consists of all the consulting and contracting firms doing business in the Nigerian building industry. However, the data were sourced from the Architects Registration Council of Nigeria (ARCON, 2016), the Council of Registered Builders in Nigeria (CORBON, 2017) and the Nigeria Institution of Quantity Surveyors (NIQS) andhttps://niqs.org.ng/) revealed that a total of 1116 firms were registered in the five cities selected (see Table 1). This translated to a sampling frame of 1116 firms. In determining the minimum sample size for the survey, Yamane (1967) sample size formula $n = \frac{N}{1+N(e^2)}$ was used. At the confidence level of 95% and e =0.05, the minimum sample size of 295 firms was obtained. However, considering the fact that the sample size calculated is a minimum value, the sample size for this study was increased by calculating 40% of each category of firms in the population making the sample size for this research to be 446 firms as presented in Table 1

Table 1: Study Population and Sample Size

Cities/Type of Firms	Architectural firms	Building Contracting and Consulting Firms	Quantity Surveying firms	Total Population	**Sample size**
Lagos (Population)	330	12	120	462	-
Sample size for Lagos	**132**	**5**	**48**	**-**	**185**
Abuja (Population)	253	31	84	368	-
Sample size for Abuja	**101**	**12**	**34**	**-**	**147**
Port-Harcourt (Population)	67	6	22	95	-
Sample size for Port-Harcourt	**27**	**2**	**9**	**-**	**38**
Kaduna (Population)	70	5	43	118	-
Sample size for Kaduna	**28**	**2**	**17**	**-**	**47**

Enugu (Population)	56	-	17	73	-
Sample size for Enugu	**22**	**-**	**7**	**-**	**29**
Total	-	-	-	1116	**446**

Data Sources: ARCON, 2016; CORBON, 2017, https://niqs.org.ng/

In the selection of object of study, a multi-stage sampling technique was applied. First, a cluster sampling procedure was used to create clusters of the firms in the aforementioned five cities. Second, within each city selected for study, participants were randomly selected.

The questionnaire used for this study was designed by the researchers and divided into sections covering six thematic areas. However, only data collected from three sections of the questionnaire are presented in this article. The sections from where the data were drawn from are Section A, which covers the respondents' bio-data. Section B used to collect data on the level of awareness and knowledge of lean practices (LPs) in the firms investigated. In this section of the questionnaire, the respondents were asked three sets of questions. First, they were asked to indicate if they are aware of lean practices in construction using "*Yes"* and ""*o"* options. Second, they were also asked to indicate if there is awareness of LP at firm level based on the 5-point Likert type scale ranging from "1" for *Not Aware* to "5" for *Very Aware*. Lastly, they were also asked to indicate their level of knowledge of seven lean principles in construction using the same the 5-point Likert type scale as previously discussed. Section D of the questionnaire helped the researchers to gather data on the level of adoption of lean practices amongst firms in the Nigeria building industry. Specifically, the participants in the surveys were asked to indicate by ticking all the lean practices they have thus far implemented from the list 32 lean practices identified in the review of literature.

The surveys took place in Nigeria between June and July 2018 with the administration and retrieval of the questionnaires. In each of the selected firms, only one staff member representing the firms was given a questionnaire to fill. Although 670 copies of the questionnaire were administered, 462 representing about 69% of the distributed questionnaires were retrieved. However, 446 representing around 97% of the retrieved questionnaires were correctly filled and subsequently, included in the analysis.

The Statistical Package for the Social Sciences (SPSS) software package was used in analyzing the data obtained from the survey. Due to the nature of the research questions, the principal type of analysis the data were subjected to was descriptive statistics, which involved the calculation of percentages and frequency distribution. The results are presented using tables and charts.

4. RESULTS AND DISCUSSION

4.1. Profiles of Respondents

Table 2 is a display of the respondents' profiles. It is evident from Table 2 that most of them were male, between the age group of 16years and 35 years, working in architectural firms, had bachelor's degree as their highest educational qualification and had less than 11 years of work experience. The result also shows that many of the respondents are architects working in firms in Lagos. The least number of participants worked in building consulting and contracting firms and in Enugu.

From this result, it can be inferred that most professionals in the Nigerian building industry are all young male adults employed by firms in Lagos and Abuja. Notably, a majority of these

professionals are well educated having a bachelor degree as their least academic qualification. Furthermore, we can also see from the result in Table 2 that most of the respondents have a significant number of years of experience in the field; and thus are eminently qualified to provide reliable data for the current research.

Table 2: Profile of participants in the survey

Attributes	Frequency (n=446)	Percentage (%)
Sex		
Male	324	72.6
Female	122	27.4
Age Grouping in years		
16-25	125	28.0
26-35	192	43.0
36-45	77	17.3
46-55	35	7.8
56 and above	17	3.8
Cities of location		
Abuja	147	33.0
Lagos	185	41.5
Port-Harcourt	38	8.5
Kaduna	47	10.5
Enugu	29	6.5
Type of firms		
Architectural	310	69.5
Building Consulting and Contracting	21	4.7
Quantity Surveying	115	25.8
Role of respondents		
Architect	256	57.4
Builder	34	7.6
Engineer	37	8.3
Project Manager	24	5.4
Quantity Surveyor	95	21.3
Highest educational qualification of the respondent		
Diploma	97	21.7
Bachelor	252	56.5
Master	85	19.1
Doctoral	12	2.7
Work experience of the respondents in years		
1-5	200	44.8
6-10	149	33.4
11-15	71	15.9
16-20	7	1.6
21-25	15	3.4
More than 25	4	0.9

4.2. Awareness and knowledge of lean practices in construction

Figure 1 shows summary of the result on the respondents' levels of awareness of lean practices in building design and construction. Figure 1 shows that the level of awareness of firms in the building industry. From the result displayed in Figure 1, it is evident that many (67%) of the respondents said they were aware of lean construction practices, while 24% claimed that they were not aware of these.

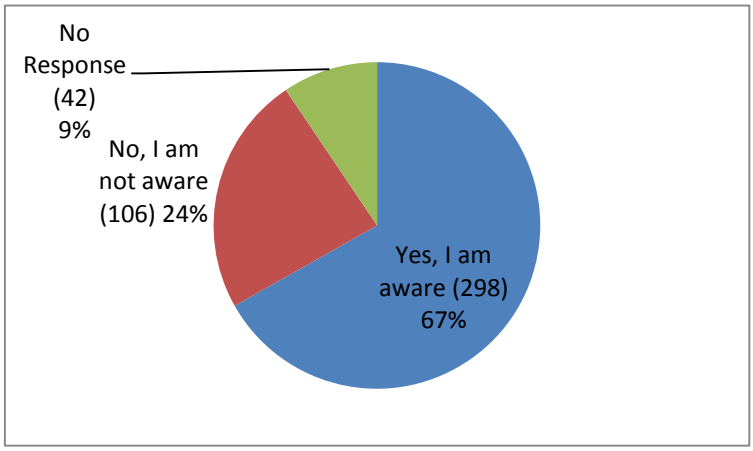

Figure 1: Respondents' level of awareness of Lean Practices in construction

The result appears to contradict the finding by Olatunji (2008) suggesting that the level of awareness of lean practices in construction was low in Nigeria as well as those in Germany (Johansen and Walter, 2007), Turkey (Tezel, and Nielsen, 2013) and Ethiopia (Ayalew, Dakhli, and Lafhah, 2016) as previously highlighted. However, this finding appears to be consistent with the previous study in Ghana by Ayarkwa *et al*. (2012) indicating a good level of awareness of lean construction amongst industry practitioners in that country. From the result of the current research, it is clear that about 10 years after that research by Olatunji (2008), the level of awareness of lean practices in the Nigerian building industry has significantly improved. This level of improvement in awareness is expected to have impact on the adoption of lean construction practices in Nigeria. This line of thinking is consistent with the postulation by Rogers (2003) that the first stage of any innovation diffusion is having knowledge about the existence of the innovation, how it works and how to apply it. The implication of this result is that about 67% of the firms who claimed that they were aware of lean practices in construction would most likely adopt them.

To further determine the extent of their awareness of the use of lean practices in construction, the respondents were also asked if their firms are aware that lean practices can be used during building design and construction activities. The result is as presented in Figure 2.

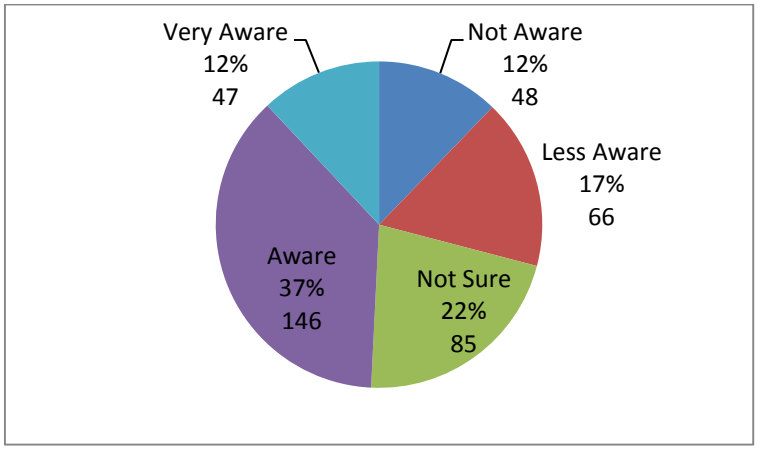

Figure 2: Firms Level of awareness on LPs use in building design and construction activities

From this result, it can be seen that around 49% of the respondents claimed that their firm was aware that lean practices can be implemented in the design and construction of buildings in the Nigeria, while 22% were not sure about this. Relating this to the earlier result on the individual awareness level, it is clear that although 67% of the respondents indicated their firms were aware of lean practices, only 49% were very certain that lean practices have been adopted by their organisation in the design and construction of buildings. This suggests that there is a difference between awareness and actual adoption of lean construction practices in the Nigerian building industry. Based on this result, it can be inferred that the level of awareness by firms about the adoption of lean practices in building design and construction processes can best be described as average.

To further ascertain the knowledge base of the particiopants and their firms on lean practices, the participants were also asked to indicate their levels of familiarity with some lean concepts and principles. The result is presented in Figure 3.

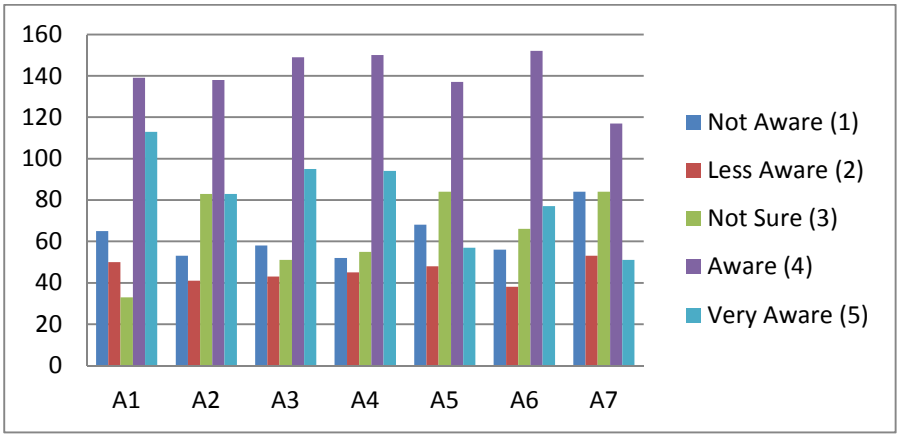

Figure 3: Level of awareness of some lean concepts and principles

A1: Level of awareness of lean as an approach that can be used in building construction

A2: Level of awareness of the difference between LPs and traditional building procurement process

A3: Level of awareness of advantage of LPs in project cost saving

A4: Level of awareness of advantage of LPs in reduction of project delivery time

A5: Level of awareness of LPs as being more concerned about the process rather than waste management

A6: Level of awareness of advantage of LPs in reduction in the generation of waste in the life cycle of building projects

A7: Level of awareness of the adoption of lean practices in other industries other than the building industry

A further interogation of the result in Figure 3 will reveal that most of the participants are farmiliar with some basic concepts and principles of lean construction. It also indicates that the level of familiarity of firms in the Nigerian building Industry with lean concepts and definitions is relatively good. This result seems to contradict findings from a similar study in Ethopia by Ayalew *et al*. (2016) which revealed that around 48% of stakeholders in the Ethopian construction industry were aware about lean construction but not familiar with the basic lean concepts such as the toyota way, prefabrication, big room and others, and that in Ghana by Ayarkwa *et al*.(2012) indicating that although the level of awareness of lean philosophy was good in that country's construction industry but the level of familiarity with its concept was low.

4.3. Lean practices adopted by firms in the Nigerian building industry

To address the second research question, the respondents were also asked to indicate whether their firms have adopted any lean practice in the course of delivery building projects. The result is as presented in Figure 4. From the result (Figure 4) it is evident that nearly one-half (47%) of the re the respondents claimed that their firms have adopted one form of lean practices or the other. This result seems contradict the observation by Oladiran (2008) that there was no adoption of lean practices in the Nigerian construction industry as previously highlighted.

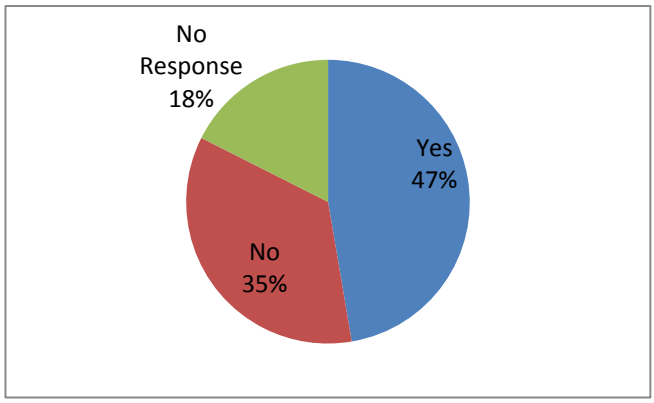

Figure 4: Adoption of lean practices among the firms sampled

The study also investigated which of the 32 lean construction practices have been adopted by the firms sampled. The result is presenetd in Table 3.

Table 3: Lean Practices adopted by the firms sampled

S/N	**Lean practices**	**Frequency**	**Percentage (%)**	**Ranking**
	Visual Design Construction (3D/BIM)	65	9.2	1
	Total quality management	53	7.5	2
	Team/partnering	50	7.1	3
	Plan of conditions and work environment	45	6.4	4
	Last planner	43	6.1	5
	Integrated project delivery	18	5.2	6
	Visualization tools (signpost and board for instruction on site)	31	4.4	7
	Total Preventive management	29	4.1	8
	Health and safety improvement	28	4.0	9
	Detailed briefing	28	4.0	9
	Just-in-time	27	3.8	10
	Work structuring and scheduling	25	3.5	11
	Pull scheduling	24	3.4	12
	Design Workshop/ big room	24	3.4	12
	Standardization	24	3.4	12
	Design structure matrix	18	2.6	13
	Benchmarking	18	2.6	13
	Target value design	17	2.4	14
	Error proofing	16	2.3	15
	Daily clustering	16	2.3	15
	Value-based management	16	2.3	15
	Conference management	13	1.8	16
	6 Sigma	12	1.7	17
	Kanban System	12	1.7	17
	Prefabrication and modularization	12	1.7	17
	On-site management	10	1.4	18
	Concurrent management	10	1.4	18
	Kaizen	8	1.1	19
	Fail safe for quality	6	0.9	20
	Location-based management	4	0.6	21
	First run study	3	0.4	22
	Gemba walk	2	0.3	23

From the result in Table 3 it is evident that all the 32 identified lean practices have been adopted by firms in the Nigerian building industry and that the adoption of individual lean practices investigated is generally low. However, some practices have been more frequently adopted than others as indicated by the respondents. In fact, three most adopted lean practices as revealed in the survey include Visual Design Construction (3D/BIM) with 9.2% of the firms

adopting it. This result is understandable because many of the respondents are architects, who most often use computer aided (CAD), 3D/4D (BIM) to support the execution of their design works ease in design and display of designs. This could also be because the practice seems to be in line with the traditional construction process in Nigeria as previous authors (Benedict, 2016; Akinola, Salau, Oluwatayo, Babalola and Okagbue, 2018 and Ibem, Uwakonye, Akpoiroro, Somtochukwu, and Oke 2018) have indicaed. Next to this is Total Quality Management (TQM) with 7.5% of the firms confirming its adoption and Team/Partnering, which has been adopted by 7.1% of the firms investigated. The two least adopted lean practices by the firms are First Run Study (0.4%) and Gemba walk (0.3%), respectively.

On the one hand, this result appears to be inconsistent with that by Oladiran (2008) indicating that there was little or no adoption of lean practices in Nigeria. It is also contrary to the finding in Ghana by Ayarkwa *et al*. (2012), which also revealed that Just-in-time and prefabrication have been the most commonly adopted lean practices using the traditional construction approaches. On the other hand, this specific finding of the study is consistent with those by Sarhan *et al.* (2017) in Saudi Arabia, which revealed that amongst the 12 lean practices investigated Computer Aided Design (CAD) was the most supportive tools towards implementation of lean construction, followed by Total Quality Management and others. The finding here is also in line with that in a study in Abu Dhabi by Al-Aomar (2012) in which 23 lean practices in the construction were investigated and visual design and construction and teamwork(Team/Partnering) emerged as the two most adopted practices.

5 CONCLUSIONS

In this study, the levels of awareness and adoption of lean practices by firms in the Nigerian building industry were examined using empirical data from a field survey. From the results presented earlier on, two key conclusions are made. The first conclusion is that many of the firms investigated have a reasonable knowledge about lean practices and what they can be used for. The second conclusion is that the three most implemented lean practices by firms in the Nigerian building industry are Visual Design Construction (VDC), Total Quality Management (TQM) and Team Work/Partnering.

From this research it is evident that although the level of awareness of lean practices among firms in the Nigerian building industry is on the increase, the level of adoption of the existing lean practices in the delivery of building projects in this country is still relatively low. Therefore, the Nigerian building industry is yet to enjoy the full benefits of the lean thinking. To reverse this trend, it is suggested that more awareness of lean practices be created among industry people in Nigeria as many of them are not aware of lean practices and the benefits associated with them. This calls for massive awareness programmes on lean practices by professional associations in the Nigerian building industry such as the Nigerian Institute of Architects (NIA), Nigerian Institution of Quantity Surveyors (NIQS), and the Nigerian Institute of Builders (NIOB). In addition, more research needs to be conducted on the barriers to the adoption of lean practices and the benefits associated these practices in the delivery of building projects.

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